

FISHERIES IMPROVEMENT COMMITTEE

by B.I. Dybern

1970

Belgium

(R. de Clerck)

Investigations have been carried out on the influence of disposal of sewage and industrial waste-water into the sea by pipe-lines and ships. Monthly analyses of fish and shrimps in the area of a proposed pipe-line outlet have been continued.

There have been regular observations on salinity, oxygen, BOD, pH, ammonia, phosphate and bacteria in the coastal waters.

Canada

(J.M. Anderson)

Anti-pollution Programmes

Many government, university, and private agencies were involved in studies on the quality of the marine environment. 1970 saw a notable example of close inter-agency cooperation during the scientific investigations into the February 4, 1970, sinking of the tanker "Arrow" carrying approximately 108 000 barrels of Bunker C fuel oil which grounded on Cerberus Rock in Chedabucto Bay, N.S. More than half of the cargo was spilled. A full report of the engineering, and physical and biological oceanographic investigations, is covered in "Report of the Task Force - Operation Oil", Volume I; Report of the Task Force Volume II, Report of the Scientific Coordination Team to the Head of the Task Force; issued by the Ministry of Transport through Information Canada, Ottawa, Ontario, Canada; Catalogue number T22-2470/1.

In investigations into the sinking of a second, and somewhat smaller tanker, the "Irving Whale", off Prince Edward Island in August 1970, the Canadian submersible PISCES I proved to be of value, particularly to the salvage master for the purpose of direct visual assessment of the wreck on the bottom.

Mercury contamination of fish from industrial wastes was a serious problem in 1970. Detection was first made in late 1969 in the Saskatchewan River of the Arctic drainage basin. Chlor-alkali plants, and to a lesser extent pulp and paper mills, have been the greatest source of industrial mercury pollution, with the most serious problem occurring in the Great Lakes Basin. Because of potential health hazards, certain fisheries were closed, putting the fishing industry in jeopardy. In general, marine species so far tested have relatively low levels of methylmercury. An exception is swordfish, in the Western North Atlantic, which contain mercury residues in excess of 0.5 ppm, necessitating a closing of the Canadian swordfish fishery. It is not known where, or how, swordfish which migrate along the Atlantic seaboard from Florida northwards, acquire their mercury contamination.

Work on the biological effects of phosphorus stimulated by the pollution accident in Long Harbour, Newfoundland, in 1969, continued. Special emphasis has been placed on field studies at the site of the accident in Newfoundland, and on laboratory work dealing with such topics as the uptake by fish of elemental phosphorus from seawater, clearance times, localization of phosphorus in tissues, and the effect of commercial processing on the degradation of phosphorus in tissues.

Studies are being made on the sensitivity of in vitro cell cultures to various pollutants, such as pesticides, herbicides, heavy metals, etc., as a possible tool for water quality bioassays.

A method has been developed to solubilize polychlorinated biphenyls (PCB's) to form optically homogeneous aqueous solutions. Like other related chlorinated hydrocarbon compounds, PCB's are concentrated in fatty tissues and appear to be as ubiquitous in residue analyses of marine organisms as is DDT. Special emphasis has been placed on the toxicity, mode of action, and sublethal effects of chlorinated hydrocarbon pesticides including PCB's, heavy metals from mining operations, oil dispersants, and pulpmill effluents, to aquatic organisms.

Large scale aerial spraying of fenitrothion, an organophosphate insecticide, over New Brunswick forests, caused no significant changes in population densities of juvenile Atlantic salmon. However, the careless handling of agricultural pesticides was the cause of many fish kills.

Pollution studies in 1970 indicated conditions of water pollution in the tidal waters of the Restigouche, Nipisiguit, Miramichi and Saint John Rivers. Industrial wastes, mainly from pulp and paper mills, contained toxic elements as well as heavy loads of solid and oxygen consuming organics.

Many of the pulp and paper companies, food processing companies, oil refineries and other industrial operators have begun or have agreed to install primary and secondary waste treatment facilities.

#### Transplantation and special fish rearing programmes

Pink salmon. Several transplants of eggs of pink salmon, Oncorhynchus gorbuscha, were made to a small river in southern Newfoundland during the period 1959-1966, the largest being 5.9 million eggs in 1966. The greatest adult return (spawning plus known commercial and other recoveries) was 8 440 fish in 1967 from a planting of 3.3 million eggs in 1965. Returns from naturally spawned eggs have occurred in 1969 and 1970 (2 603 total return in 1969 from 5 334 spawning adults in 1967; 2 089 total return in 1970 from 1 353 spawning adults in 1968).

Atlantic salmon. In 1970, the third year of operation of the Mactaquac Fish Culture Station on the Saint John River near Fredericton, New Brunswick, a total of 413 000 Atlantic salmon smolts were released. The total was comprised of 361 000 2-year smolts and 52 000 1-year smolts, all exceeding 15 cm in fork length.

A 5-year salmon smolt tagging programme was initiated in 1968 to (a) evaluate the contributions of the 13 Maritimes Fish Culture Stations to sport and commercial fisheries, and (b) to provide information to increase the effectiveness of the existing rearing programme. In 1970, 137 000 hatchery-reared salmon smolts of five stocks were tagged and released in five river systems.



Oysters. Scallop shell planting, at Summerside Harbour, Prince Edward Island, has been shown to significantly increase oyster spat development. Off-bottom rearing experiments were started to determine optimum tray rearing densities for specific ages and sizes of seed oysters. Information is also being collected on growth and survival of oyster spat on various types of commercial collectors now in use.

Observations have been continued on the Ostrea edulis reared in the experimental hatchery at Ellerslie, Prince Edward Island, in 1969. Over-winter survival was excellent, despite the five-month period, normal at Ellerslie, of water temperatures at or below 0°C. Through the summer of 1970, growth and survival continued to be very good. At least some individuals spawned. One female carrying larvae was found in July. At the end of 1970 growing season, at an age of fifteen months, the mean size and total weight reached was 63 mm and 24 g. The largest individuals approached 8 cm in length and a total weight of over 40 g. In 1971 an attempt to establish self-sustaining natural populations in desirable areas will be made and observations on growth and sexual development continued.

In 1970 private commercial application of shell-string culture of oysters (Crassostrea virginica) was begun in the Bras d'Or Lakes of Nova Scotia, an area with a great potential for oyster production but with limited suitable bottom areas. With Federal advice and supervision, brood stock was introduced and prediction and monitoring of larval settlement carried out. A satisfactory set was obtained on shell strings. Growth during 1970 in oysters of both the 1969 and 1970 year classes was good. A technique of supporting the strings on cables strung over deep inlets has been developed which promises to cope well with winter ice and to give good growth at low cost.

#### Denmark

(O. Bagge)

In connection with investigations on the pollution conditions in the Limfjord caused by the urban areas of Ålborg and Nørre Sundby, the content of heavy metals (Pb, Cu, Zn and Hg) in Mytilus edulis has been determined.

#### Finland

(A. Voipio)

Marine pollution investigations have been carried out in several coastal areas, among other things the measurements on primary production (especially in the Gulf of Finland). During 1970 the levels of total and phosphate phosphorus were, as a whole, somewhat higher than during the preceding years, but the primary production did not show any significant increase corresponding to this (being about 30-40 g/m<sup>2</sup>/year).

Investigations in connection with the sewage problem of Helsinki include fishery biology. Among the studies are those on the effects on the taste of the fish meat caused by the eutrophicated conditions.

In some samples from marine environmental investigations the cadmium content showed to be low (Dept. of Radiochemistry, University of Helsinki.)

France  
(L. Marteil)

Crustacés

Homards - Des essais d'élevage de Homarus vulgaris ont donné des résultats satisfaisants, le taux de survie au 4ème stade atteignant 20%. La croissance des animaux nés en 1968, 1969 et 1970 a été bonne.

Un essai d'acclimatation de Homarus americanus en vivier est en cours. Les essais d'hybridation n'ont pas donné, jusqu'ici, des résultats positifs.

Langouste - De nouvelles immersions de Jasus lalandei ont été faites en 1970 sur les côtes de Bretagne. Les résultats des essais tentés en 1969 avaient été satisfaisants.

En revanche, les expériences avec Jasus tristani ont été infructueuses, les animaux résistant mal à un long séjour en vivier dans les conditions de milieu du nord de la Bretagne.

Mollusques

La croissance de Crassostrea gigas dans les eaux françaises a été très bonne, que le naissain ait été importé du Japon ou des USA, des bancs naturels ou des "hatchery".

Pollution

Une centaine de produits commerciaux utilisés dans la lutte contre les pollutions par hydrocarbures ont été testés; l'étude a permis de sélectionner les plus efficaces et les moins dangereux pour la faune ou la flore.

Une méthode d'analyses a été mise au point pour la recherche et le dosage du mercure dans les eaux.

L'étude des pollutions littorales d'origine urbaine a été poursuivie.

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Programme 1971 : Poursuite des études sur les crustacés et les mollusques.

Recherche des pesticides dans les eaux.

Germany  
(H. Mann)

Fish rearing and fish cultivation

Rearing experiments with sole, turbot and other North Sea fishes were continued along previous lines by the Biologische Anstalt, Helgoland. Studies on the adaptation of salmonids to sea water were also continued. During these tests the most resistant fishes were selected for culturing experiments. Other studies were related to Belone acus and to sub-tropical fish.



Culture tests on rainbow trout, sea trout and brown trout were continued. Smolts did not adapt to higher salinities.

Investigations on the stocking of a brackish water pond at Cuxhaven were continued.

#### Water pollution

Investigations on bacterial decomposition of heavy oils in sea water, already started in the previous year, were completed. Besides, experiments on oil-absorbing agents were conducted and studies on the effects of crude oil and its fractions on eggs and larvae of herring, plaice and cod were carried out at the Flødevigen Laboratory, Norway.

Studies on the decomposition of detergents in sea water were completed and investigations on the toxicity of non-ionogen detergents started. The experiments were carried out with different types of emulsifying agents. It was found that Crangon crangon was unsuitable for such tests as it has a strong resistance to toxic substances.

In various institutes residues of mercury and pesticides in fish and other marine animals were investigated. Studies on the effect of iron compounds on fish in sea water revealed great damage in the form of coagulation of the gills.

Examination of the effects of waste water on the bottom fauna in the area northwest of Helgoland was continued. So far no negative effect of sulphuric acid and iron sulphate on the bottom fauna has been observed. Experimental studies on the effect of ferric hydroxide on the behaviour and growth of Mytilus edulis showed accumulation of iron in the tissues of the mussels and strong reduction in weight.

Experiments on the sensitivity of plaice eggs to wastes from a titan factory were made.

#### Iceland

(J. Jónsson)

Nothing to report for 1970.

#### Ireland

(F.A. Gibson and D. de G. Griffith)

#### Cultivation and transplantation

Mr C. Duggan of the Department of Agriculture and Fisheries continued growth and survival experiments with the American Hardshelled Clam, Mercenaria mercenaria. Particular attention was given to transplantings in the heated effluent waters of a power station in the estuary of the River Shannon.

#### Marine pollution

In conjunction with Gulf Oil Co. the Department of Agriculture and Fisheries set up a Fellowship to study the intertidal fauna of Bantry Bay in south-west Ireland, where Gulf Oil has a crude oil storage terminal. Mr G. Crapp is making a detailed study of the intertidal species.



Laboratory work by the Department of Agriculture and Fisheries for 1971 includes investigations into the toxicities of new and recently produced oil dispersants (Mr D. Griffith).

The three-year project on organochlorine pesticide residues in Irish rivers, carried out by Mr P.J. Timpson of University College of Dublin, was concluded. Detailed studies of the pesticide levels of water, mud, insects and trout (Salmo trutta) were made in two rivers out of more than twenty rivers and lakes in the main survey, which involved the examination of tissues of trout, salmon (Salmo salar) and pike (Esox lucius). A new programme was commenced in 1970 to investigate the levels of nutrients in over 70 rivers and lakes.

Mr P. Toner of An Fóras Forbartha (National Institute for Physical Planning and Construction Research) commenced a survey of the major catchments in the country to gather information on the quantity and quality of Ireland's surface waters. Chemical and physiological measurements include calcium and total hardness, alkalinity, ammoniacal nitrogen, albuminoid nitrogen, chloride, 5-day BOD, 4-hour permanganate value, chlorine, pH and dissolved oxygen. Biological assessment of water quality is being made chiefly with reference to the composition of the invertebrate fauna communities. This work is expected to be completed by late 1971.

#### Netherlands

(P. Korringa)

Sanitary control of shellfish gave no reason for concern in the year 1970, since the oyster basins and mussel cleansing plots at Yerseke appeared to be no longer under the influence of the sewage discharged by the city of Goes. The chlorination of the water of the canal receiving this waste, prior to its outfall in the Oosterschelde, worked to satisfaction. In the meantime a pipeline for discharge of all sewage of the city of Goes into the Westerschelde is under construction. The increasing number of yachts coming to the Oosterschelde in summer should receive some attention, since the presence of people aboard such yachts can locally lead to increase of coli bacteria in the sea water. The local authorities at Yerseke have been advised to keep this development under control on behalf of the shellfish industry.

Again, a plankton survey was carried out in the Dutch coastal waters, at regular intervals, in an effort to trace possible outbreaks of dinoflagellate populations. The year 1970 did not bring such dinoflagellate outbreaks in the Dutch coastal waters. Phytoplankton blooms did occur, but consisted predominantly of diatoms. The general impression is that the nutrients discharged by the river Rhine will lead to blooms of phytoplankton, but that for some still poorly understood reason diatoms are the first to take advantage of this influx.

Of the pollution problems dealt with in the year 1970 investigations on contamination with mercury compounds predominated strongly. This mainly because of public concern and measures taken by several countries importing fish. The general situation is that the Dutch Public Health Authorities see as yet no reason to impose restrictive measures on the consumption of fish from the Dutch waters and from the North Sea, taking into account the quantities of mercury actually found in such fish and the fish consumption pattern in the Netherlands. Export problems are the primary concern of the Dutch fishing industry. The scientific investigations concentrated on finding the relation between age (and thereby size) of the fish and its content of alkyl-mercury. In this the pike-perch from the IJsselmeer got most of the attention since the IJsselmeer contains a higher percentage of water from the river Rhine than the coastal water and the Waddenzee.



Laboratory investigation revealed that it is not the total quantity of mercury as such which is decisive for the quantities of mercury accumulated in the food chain. It was demonstrated that the bivalve Anodonta can accumulate mercury rapidly in the form of dimethylmercury, but that mercury will not be accumulated at all when offered in the form of mercury sulphide, not even when large quantities of it are introduced into its environment.

Investigations on the herring nematode Anisakis marina were continued in the year 1970. Analysis of herring samples indicated that the tendency to decline in numbers could again be observed in the year 1970. The three and four year old herrings from Botney Gut, Sandettie and English Channel appeared to be responsible for the low overall figures. The Flamborough-Whitby herrings on the other hand, revealed quite high figures : on an average 13.3 Anisakis per herring. The percentage of North Sea herring carrying Anisakis remains still high : between 90 and 100%, whereas the herring of the Irish Sea showed a percentage of between 20 and 40 only, with 2 Anisakis on the average per herring. Herring from the waters around the Isle of Man revealed the lowest infection rates of the entire Irish Sea. Herring in the enclosed Veerse Meer (Zeeland) appeared to be virtually free of Anisakis: in only one 7 year old herring the nematode was found.

The incidence of Anisakis in mackerel was investigated in a first attempt to use such figures for the identification of mackerel stocks. Three year old mackerel from the north-eastern sector of the North Sea appeared to be 100% infected with over 16 Anisakis per mackerel.

Investigations on the life cycle of Anisakis marina were continued. Maturation (followed by egg deposition) of juvenile Anisakis taken from the fish could be accomplished under laboratory conditions and the eggs produced hatched and could be reared to the larval stage.

Investigations have been carried out on the occurrence of Contracaecum in some species of North Sea fish, and on Lymphocystis and Glugea infections in flatfish.

#### Publications 1970

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| Korringa, P.    | 1970 | "Bestrijding van de verontreiniging van de zee".<br>Visserijwereld, jrg. 29, no.51, 6 pp.  |
| Korringa, P.    | 1970 | "De zee als voedselbron".<br>Chemisch Weekblad, jaargang 66, De Zee, pp. 23-30.  |
| Korringa, P.    | 1970 | "Verontreiniging van het water".<br>Het Verstoorde Evenwicht; Een pleidooi voor behoud van het natuurlijke milieu. Oosthoek, Utrecht, 1970, pp. 30-48.                         |
| Korringa, P.    | 1970 | "De vermeende onkwetsbaarheid van de wereldzee".<br>Op hoop van leven; Europees natuurbeschermingsjaar 1970, pp. 62-67.  |
| Korringa, P.    | 1970 | "The basic principles of shellfish farming on the continental coast of Europe".<br>Symposium on Mollusca Marine Biological Association in India (1968), Part III, pp. 818-823. |
| Roskam, R. Th.  |      | "De verontreiniging van de zee".<br>Chemisch Weekblad, jaargang 66, De Zee, blz. 56-61.  |



Norway  
(R. Ljøen)

Rearing and cultivation

Experiments on the cultivation of mussels (Mytilus edulis) done at the Institute of Marine Research were partly ended during the autumn 1970. At good growth localities the mussels reached market size and could be harvested 14 months after the spat fall.

The investigations on oysters (Ostrea edulis) were entirely focussed on practical problems and experiments on a new type of spat collector were carried through. For the present 6 polls for spat production are operated and last year 8 tons of spat (one and two years old) were exported. The production of oysters for human consumption is estimated to 150 000 - 200 000 in number.

The qualitative investigations on fish eggs and larvae from Arcto-Norwegian cod, plaice and other flatfish species were continued in 1970. Special attention is being paid to the intraspecific variation in eggs from mothers of different age, and at different time in the spawning season. The size and weight of the eggs and the growth of the yolksac larvae were measured.

The intraspecific variation on eggs and larvae were studied both within the same population and between different populations of the same species.

Intraspecific variation in the growth of later stages has been recorded from plaice larvae fed on Artemia.

The problems of artificial food for marine fish larvae were taken up and techniques for automatised feeding have been developed.

In order to obtain eggs for a long period, sex-hormones and cold water treatment were tried to induce or delay spawning.

In connection with the intraspecific investigations on eggs and larvae, experiments with different temperatures have been carried out to obtain the optimal conditions.

Water pollution

During the last year the conditions and the effect of pollution at some fjords in the eastern, southern and western parts of Norway have been studied.

The Norwegian Institute for Water Research, which mainly carries out investigations according to contract of municipal authorities and industries, has investigated the Kragerøfjord, the Frierfjord, the Sandebukt, and a region of the eastern part of the Oslofjord in order to evaluate their conditions as recipients for sewage and industrial effluents.

The Institute of Marine Research made a pollution survey of the Trondheimfjord in order to elucidate the degree of eutrophication, the particulate contamination and the presence of toxic agents. The report was presented at the FAO technical conference on marine pollution in Rome, December 1970.

Primary production and the productive indices were analysed in different polluted fjord systems together with mercury contaminations in fish and sediments.



The Institute of Marine Biology, the University of Oslo, has continued the studies on the influence of polluted water on fundamental biological processes, the variation in different nitrogen compounds in polluted water systems, and the effect of purified and untreated sewage water on shellfish. Studies on the primary production in the Oslofjord have also been carried out.

Problems related to chlorinated aliphatic hydrocarbon from PVC-industries were studied. The problems were discussed in a report presented by a joint Norwegian/Swedish group at the FAO conference mentioned above.

Further work has been carried out in the laboratories at the Institute of Marine Research to study also the accumulation of the C - Cl - compounds in fish liver.

Water and sediment samples from a locality adjacent to the only Norwegian PVC production plant were analysed. The results indicated contamination in the water masses.

The contents of some recaptured containers with industrial waste from the North Sea bed were analysed. A report was made to the FAO conference, and the problems of dumping of the containers was discussed in relation to fishing operations.

Because of alarming information of persistent organic matter and heavy metals being dumped into the sea the Institute of Marine Research asked the national authorities on a Nordic basis to propose prohibitive measures against such dumpings.

The variation of pH in Norwegian freshwater is studied and investigations of the effect such variations may have on the population of salmon and trout in Norwegian waters were continued at the Directorate for Wildlife and Fish Management.

#### Poland

(W. Mańkowski)

For some years intensive investigations on the influence of phosphogypsum (gypsum disposal from wet process phosphoric acid plants) on the physical and biological environment of the Baltic Sea have been carried out. These investigations have been made simultaneously in the sea and in laboratories. Three phases can be distinguished:

1. Laboratory studies on the chemical composition of phosphogypsum derived from raw materials of various origin.
2. Field studies, including
  - a) the behaviour of the mass of phosphogypsum in the sea;
  - b) the influence of phosphogypsum on the chemical composition of the Baltic Sea;
  - c) influence on primary production;
  - d) influence on zooplankton;
  - e) influence on the bottom fauna.
3. Experimental investigations (in aquaria) on the toxicity of phosphogypsum :
  - a) to establish the lethal concentrations for chosen vertebrate and invertebrate organisms;
  - b) to establish the effect of fluorine contained in phosphogypsum on marine organisms.

It is not yet possible to draw any certain conclusions as to the degree of toxicity of phosphogypsum in the sea environment and the investigations will therefore be continued.

Portugal

(H. Vilela)

The problem of mercury pollution has now been taken under consideration.

Spain

(R.C. Garcia Cabrera)

Les travaux réalisés en Espagne sur l'amélioration des pêches ont été faits principalement aux Iles de Fuerteventura, Lanzarote et Gomera. Nous avons enseigné aux pêcheurs locaux l'emploi de nouvelles nasses pour la capture de crustacés et environ cinquante d'elles ont été cédées aux pêcheurs.

Les nouvelles pêcheries de crustacés donnent actuellement un très bon rendement.

Des études ont été faites sur les différents types d'appâts, de nasses et de nature des fonds, ceux-ci ne permettant pas le chalutage aux Iles Canaries.

Nous avons également fait des essais avec de petits palangres superficiels pour la capture des thonidés avec des résultats moyens.

Sweden

(B. I. Dybern)

Baltic Sea

The extensive research programme for the Baltic has been continued. Among the most important projects are those considering toxic substances in sediments and organisms. Due to high content of mercury in fish (mean values of more than 1 mg Hg/kg wet weight fish) some coastal areas are black-listed as fishing areas, which means that fish from them must not be sold or given away as gifts. The fishermen themselves, are, however, allowed to eat the fish at their own risk if they want. The most important areas are in the archipelago of Stockholm, the Bight of Gävle and the Bråviken.

The DDT and PCB contents of fish show higher average values in Baltic fish than in fish from the Kattegat-Skagerak area. Very high levels can be found in certain fish-eating birds (as guillemots and white-tailed eagles) and in seals. Due to the high content of DDT, it has recently been forbidden to land and sell cod-liver from the Baltic in Sweden.

Toxicological investigations have also shown that in some parts of the Baltic dieldrine and cadmium are likely to be a problem.

Among other activities carried out in the Baltic, a river mouth survey of a number of pollutants, carried out by the rivers into the Baltic, should be mentioned, as well as a survey of the wastes from a number of coastal cellulose industries, investigations on 137 Cs in fish (pike) and sediments, and the establishment of a network of biological diagnostic stations where long-term fluctuations of the fauna will be followed.

Most of the investigations mentioned are carried out by the Fishery Board and the National Nature Conservancy Board. Besides, there are a number of more local investigations in polluted areas by these and other institutions.



### Oresund

Most investigations on the heavily polluted Oresund have been carried out within the frame of the Danish-Swedish Oresund Water Committee, but there is also more independent research work going on.

Mercury pollution is a problem and on the Swedish side part of the Bight of Lundåkra is black-listed. The contents of DDT and PCB in fish is also relatively high.

### West Coast

Generally spoken the contents of toxic substances are lower in the Kattegat-Skagerak area than in the Baltic and the Oresund, but near the coast there are some problems. Thus, a small area outside the river Viskan (northern Kattegat) is black-listed due to a high content of dieldrine in some fish and at the Skagerak coast high values of mercury have been found in populations of eiders (Somateria mollissima).

In connection with existing or future pollution situations local, but often very extensive, investigations have been carried out at about ten sites, and in addition to this there is a river mouth survey of the pollution status of the river water carried out into the sea.

The cooperation between Sweden and Norway concerning the Idefjord area at the border between the two countries has continued, and a joint work study on the distribution and influences of aliphatic hydrocarbons from PVC industries has started. Such wastes have been dumped by ships, e.g. outside the Norwegian coast, among others from Swedish industries.

### United Kingdom

#### 1. England and Wales

(H. A. Cole)

Work continues on the improvement of larval and post-larval rearing techniques for plaice (Pleuronectes platessa), sole (Solea solea) and lemon sole (Microstomus kitt Walbaum) with special regard to live and artificial food requirements, population density effects, the influence of selected physico-chemical variables and disease.

Recent research shows that the indigenous marine rotifer Brachionus plicatilis can replace the imported Artemia salina nauplius as a larval flatfish food, and that population density effects on post-larval plaice and sole growth may be described in mathematical terms. Chlorine, when used as an antifouling agent in power station cooling systems, can cause median mortality among newly-hatched flatfish at concentrations as low as 0.02 ppm, and retard growth at sub-lethal levels. Teramycin, a broad-spectrum antibiotic, when administered orally, improves the condition of captive flatfish under bacterial attack.

New research projects under consideration include techniques for the large-scale culture of rotifers, inter-specific density effects among populations of mixed flatfish species, metabolite derivatives as growth depressants, further trials with artificial foods, and an attempt to rear the haddock (Melanogrammus aeglefinus).

Genetic studies on the production of inbred lines by gynogenesis continued. Several dozen gynogenetic offspring from a number of plaice females were reared through metamorphosis for subsequent selection and breeding at maturity. The future plan is to establish several clones from these fish.

Triploid plaice and triploids from plaice and flounder hybrids were produced by cold treatment of fertilized eggs. They appear to grow faster than diploid fish. Gonad development was abnormal in juvenile



triploids and these fish should be sterile. Induction of triploids is thus a way to prevent maturation of gonads in farmed fish. Similar attempts to produce tetraploid fish have failed so far. Suppression of the first cell division of the embryo was achieved but nuclear division occurred to produce a binucleate egg cell. At the second embryonic mitosis, this cell divided twice to produce a near normal diploid embryo.

Comparisons were made between plaice, plaice x flounder hybrids and the backcross plaice x hybrid. Growth rate was highest for the hybrid and intermediate for the backcross. Phenotypically the hybrids and backcrosses show an additive type of inheritance for those characters which distinguish the plaice and flounder.

Rearing trials were started with captured 0-group turbot. These will supply information on growth rates, hierarchies, food conversion rates and mortality under possible farming conditions.

#### OYSTERS

A study has been made of the factors affecting the changes in the gonad during the conditioning of the breeding stock prior to spawning. An important finding has been that over 80% of Ostrea edulis conditioned in the laboratory have functioned as males during the first sex phase.

The work on the importance of diet in larval rearing has continued and 27 combinations of 2 or 3 species have been tested. Seven of these have given results as good or better than our standard mixture of Isochrysis and Tetraselmis.

A major effort is being made to define the conditions required to obtain the maximum growth rate and survival of hatchery reared oyster spat from 0.5 to 10 mm in size.

#### CLAMS

A study of the growth rate of hatchery reared spat of Venerupis decussata planted in the Menai Straits and on the South coast of England has now been completed. The results show that on average 10 mm spat take 3 years to reach a marketable size of 45 - 50 mm. Survival over a 2-year period has generally been 50-70%.

#### PRAWNS

The value of the most favourable compounded diet to Palaemon serratus has been tested over 95 days. Although growth was not as good as on live food (Mytilus), the growth rate showed no sign of declining and survival was equally good.

Successful rearing of the larvae of the spot prawn, Pandalus platyceros, was still erratic. Some of the variation has been found to be due to the eggs being adversely affected by elevated temperatures. Prawns have been grown to a weight of 6.6 g at an age of 8 1/2 months.

### 2. Scotland

(A.D. McIntyre)

#### Fish Cultivation

Studies of the sand ecosystem on a flatfish nursery ground in Loch Ewe sea loch continued to provide information relevant to the cultivation of plaice stocks. Populations of prey and predators were monitored and in particular methods were developed for census of epifauna populations using a towed vehicle manned by two divers. Comparable studies are also under way on a muddy ground where the largest important benthic animal is Nephrops norvegicus.



Monitoring of the Ardtoe sea water enclosure of the White Fish Authority was continued and a report is being prepared describing the changes which take place in the sea bed deposits and the fauna of an intertidal area when it is converted to a permanently submerged pond.

#### Mussel Cultivation

Growth and condition of cultivated mussels in Linne Mhuirich, an inlet of Loch Sween on the west coast, were again good in 1970, and it was confirmed that harvesting should occur in the autumn and winter 14 - 18 months after settlement. Though the experiments in Linne Mhuirich have been concluded, advice has continued to be given to the operator who is setting up a commercial undertaking there. The parasite Mytilicola intestinalis has been found in 84% of cultivated mussels examined in Linne Mhuirich, with an average of 3.7 parasites per infested mussel.

Cultivation experiments in Loch Beag in Sutherland yielded a very heavy spatfall.

#### Pollution

Surveys : Routine hydrographic, chemical and biological sampling has continued in Loch Linnhe and Loch Eil in relation to pulp mill effluent. In addition a preliminary survey of the lochs has been made using underwater television. Numerous fish and epifauna species were observed, but there was no evidence of pulp fibre build-up.

Detailed surveys were made of the Firth of Clyde with a view to determining levels of pollution and their interaction with plankton and benthos. The main pollutants studied at present are nitrate (from domestic and industrial sources) and copper. This work was followed up at the experimental level by studying the effects of copper on the invertebrate fish food chain over several months in tanks.

Shellfish : Facilities were set up in 1970 for determination of the sanitary status of shellfish beds. While the initial effort was directed mainly at the selection of methods and acquisitions of equipment, coliform examination has been made of water and mussels (Mytilus edulis) from various parts of Scotland. A number of enquiries have been received about methods of shellfish purification, and advice given.

Investigations have been made of lobster mortalities in refrigerated storage units, and while the cause has not yet been isolated, goffkaemia has been ruled out.

#### Monitoring of Pollutants

The routine monitoring of organochlorine residues in fish was continued in 1970, at the Freshwater Fisheries Laboratory, Pitlochry, five species of fish (herring, mackerel, plaice, cod and whiting) were sampled twice, in spring and autumn from six areas off the Scottish coast. The general pattern of the results was similar to that found in 1969, the fish from the Firth of Clyde again containing higher concentrations of both PCBs and organochlorine pesticides than fish from other areas.

Further analyses of seal blubber samples were obtained, using an improved technique which separates PCBs and thus eliminates their interference with pesticide residues. The highest PCB concentrations so far found in seals from any waters in the North Atlantic area were from south-east England, the west coast of England and the Firth of Clyde. Total DDT residues in English seals are exceeded only by those in seals from the Gulf of St Lawrence and possibly the Baltic. Concentrations of PCBs in the extractable lipids of seal pups found dead in south-west England were up to 2 700 ppm. Fin whales from Greenland contained organochlorine levels in blubber which were similar to those in Arctic ringed seals, with PCBs up to 5 ppm and total DDT up to 7 ppm.



As part of the 1969-1971 OECD study of pesticides in the environment, herring and mussel samples were analysed from several areas, including some believed to be polluted by organochlorine compounds.

Several samples of Atlantic salmon were obtained from West Greenland and Scottish estuaries for organochlorine analysis, but the residue levels in all cases were low. All pesticide residues were below 0.1 ppm and PCBs below 0.5 ppm.

In addition to the above monitoring programme, following the deaths of over 12 000 sea-birds, mostly guillemots, in the Irish Sea-Firth of Clyde area in the autumn of 1969, an investigation was made of the sources and distribution in the environment of organochlorine pesticides and polychlorinated biphenyls (PCBs). High concentrations of PCBs were found in the livers of most of the dead birds examined. A large number of samples of water, effluents, plankton, shellfish and fish were analysed, and higher concentrations of PCBs were found in herring, cod, whiting and mussels from the Clyde Estuary than in similar samples from other Scottish waters. The concentrations were not, however, significantly different from those found in earlier samples from the Clyde. The compounds were not detectable in sea water samples or in any effluents, but sewage sludges from a few of the sewage treatment plants in the area contained up to 14 ppm in wet sludge, derived from industrial usage. The Irish Sea and Thames Estuary also receive PCBs from the dumping of sewage sludge.

Analyses of a wide range of fish and other marine organisms were begun for mercury residues, and both methyl mercury and total mercury concentrations have been determined. The total mercury technique (using atomic absorption) was, however, not entirely satisfactory, and is being further investigated.

In collaboration with the Marine Laboratory, Aberdeen, analyses of water, sand and molluscs were made as part of an experimental study of the effects of DDT contamination of the marine environment on the food chain of plaice. A very high concentration factor from water to Tellina was found, of the order of 30 000 times.

#### U.S.S.R.

(A.F. Karpevich)

#### Rearing and Transplantation

In 1970 fish rearing plants in the Murmansk and Arkhangelsk regions released about 8 millions of smolts into the rivers Umba and Onega. The down-stream migration took place under favourable conditions.

In the same year, adult specimens of salmon (plant reared and released in a number of 10 millions and grown in natural conditions) which made a down-stream migration, returned into the rivers of Northern Europe and U.S.S.R. In the catches taken in the Murmansk and Arkhangelsk regions more than 400 humpback salmons were registered. The survival was higher as compared with that of previous years but still remained extremely low. Spawning conditions in 1970 were favourable.

In 1971 the following subjects concerning humpback salmon will be investigated :

1. The conditions for formation of natural stocks :
  - down-stream migration of young salmon born under hatchery and natural conditions;
  - abundance of mature specimens as potential producers of new stocks.
2. Possibilities of production of humpback salmon stocks in sea water for commercial purposes.



During 1966-1970 numerous captures of sturgeons (Acipenser barii and A. güldenstädti) were registered; thus about 180 specimens were caught in the Bights of Riga and Pärnu, the Gulf of Finland, the Bothnian Sea and off the east coast of Sweden. The young sturgeons which in a number of about 40 000 were released into the Gulf of Finland and the Bight of Riga during the period 1962-1966 then seem to survive and grow well. (About this see papers by G. Otterlind, ICES, C.M. 1970, E:13 and by E.A. Kairov & E.M. Kostrichkina, Trudy of VNIRO, vol. 76, 3, 1970).

In 1970 specimens of Oncorhynchus keta were released into the rivers of the Bight of Riga with the intention to study its downstream migration and survival.

We are most grateful for all reports to the VNIRO concerning recaptures in the future of the species mentioned above.